ABSTRACT

**Aims:** To determine the proximate and mineral composition of juices of some Nigerian fruits.

**Study Design:** Completely randomized design (CRD) was used in the experiment. The data obtained were subjected to analysis of variance (ANOVA) to determine if significant differences existed between the means of the different fruits. Where differences existed, Duncan’s Multiple Range Test (DMRT) was used to compare the difference between the means. The experiment was conducted at the Department of Chemistry, Ignatius Ajuru University of Education Port Harcourt between January to March 2012.

**Methodology:** *Psidium guajava, Musa paradisiaca, Carica papaya L., Citrus sinensis, Malus domestica, Citrus lanatus, Annona muricata, Irvingia gabonensis,* and *Ananus comosus* were purchased in Rumuolumeni market, Port Harcourt in Rivers State of Nigeria and were analysed. The determinations of the proximate and mineral composition of the juice samples of the fruits were determined with the use of Atomic Absorption Spectrophotometer (AAS) (Perkin-Elmer Model 372) instrument according to Association of Analytical Chemist (AOAC), (1990) procedures.

**Results:** The least crude fibre was found in *Malus domestica* (0.00%) and the highest in *Citrus sinensis* 3.55 ± 0.02%); protein values, of 1.28 ± 0.10%, 1.25 ± 0.21%, 1.05 ± 0.32%, 1.40 ± 0.10%, 1.50 ± 0.21%, 0.80 ± 0.15% and 1.05 ± 0.10% for *Psidium guajava, Musa paradisiaca, Carica papaya L., Citrus sinensis, Malus domestica, Citrus lanatus, Annona muricata, Irvingia gabonensis,* and *Ananus comosus* respectively.

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0.01% were obtained for *Psidium guajava*, *Musa paradisiaca* and *Citrus lanatus* respectively. Low lipid contents were obtained from analysed samples. High carbohydrate values of 18.46 ± 2.80%, 18.26 ± 2.51% and 16.05 ± 1.32% were obtained for *Citrus sinensis*, *Carica papaya* L. and *Annona muricata* respectively. The value of dry matter was highest in *Citrus sinensis* (25.00 ± 3.13%) and least in *Citrus lanatus* (10.40 ± 0.63%). High moisture values of 89.60 ± 3.52%, 87.30 ± 4.32% and 85.07 ± 2.50% were obtained in *Citrus lanatus*, *Carica papaya* L. and *Annanus comosus* respectively. Generally the ash content of the fruits was found to be low. The mineral analyses showed that the potassium content of these samples were relatively high with *Musa paradisiaca* having the highest value of 380.05±6.85 mg/g compared with *Annona muricata* 26.15 ± 4.21 mg/g with the least value. Concentrations of iron, magnesium, zinc, and calcium were highest in *Annanus comosus* (3.28 ± 0.20 mg/g), *Musa paradisiaca* (45.71 ± 4.55 mg/g), *Irvingia gabonensis* (1.26±0.30 mg/g) and *Carica papaya* L. (84.90 ± 3.57 mg/g) respectively. 

Conclusion: The results showed that these fruits have safe and adequate dietary nutrients if consumed in the right proportion.

Keywords: Fruits; mineral content; carbohydrate; ash; lipid; protein; Nigeria.

1. INTRODUCTION

Nigeria has abundant variety of fruits which are rich sources of nutrients and minerals to the populace. Nigeria as a developing country is experiencing food shortage as a result of population growth, competition for fertile land, poverty, lack of agricultural inputs, poor loan scheme and incentives [1]. The diets of most Nigerians are high in carbohydrates and deficient in protein. Nutritionists have advised that eating at least five portions of fruits and vegetables a day can help people to maintain good health throughout their lives, protecting them from heart disease and cancer, type 2 diabetes and kidney stones [2,3,4]. Fruits, such as oranges, banana, watermelon, pineapple, guava, pawpaw abound in Nigeria and are consumed heavily in season because storage technology is not available to preserve the excess production. Fruits contain organic acids especially ascorbic and citric acids with the latter predominating. Dietary fiber is an essential aspect of good nutrition. Intake of dietary fiber alters the water content, viscosity, and microbial mass of the intestinal contents, resulting in changes in the rate and ease of passage through the intestine. High intake of dietary fiber plays a significant role in weight control and the prevention of several diseases. For example, dietary fiber improves glucose tolerance by delaying the transport of carbohydrates into the small intestine, thereby reducing the risk of diseases and constipation [5]. Fruits contain high quantity of water, carbohydrates, vitamins A, B1, B2, C, D and E; and minerals such as calcium, magnesium, zinc, iron, potassium and organic compounds which are required in small amounts, to make the body function properly [6-9]. Many fruits are used to make beverages and fruit juice (orange, apple, grape juices etc.) or alcoholic beverage such as wine and brandy. Iron (Fe) is required for energy and endurance because it delivers oxygen throughout the body. Iron is said to be an important element in the diet of pregnant women, nursing mothers, infants, convulsing patients and the elderly to prevent anaemia and other related diseases [10]. The recommended daily allowance of iron for men is 7mg /day and 12-18 mg/day for women during pregnancy [9,11-12].

Magnesium (Mg) is used to prevent muscle cramping and it enhances nerve functioning, relieves tight sore muscles and improve bone density [1]. Magnesium plays a major role in relaxing muscles along the airway to the lung thus allowing asthma patients to breathe
easier. The daily value for magnesium is 320mg/day and deficiency of magnesium in man is responsible for severe diarrhoea, migraines, hyper-tension, cardiomyopathy, arteriosclerosis and stroke [1]. Zinc deficiency has been largely attributed to the high phytic acid content of diets leading to poor growth, impairs immunity, and increases morbidity from common infectious diseases and increases mortality [13]. Zinc is involved in thousands of bodily functions such as proper cell growth and testosterone production [9]. Zinc is said to be an essential trace element for protein and nucleic acid synthesis and normal body development. It plays a central role in growth and development. It is vital during periods of growth in infancy, adolescence and during recovery from illness [13]. In view of the nutritional and health benefits of fruits, the pulp of nine known fruits from Rivers State were analysed for their proximate and mineral composition which was designed to contribute to the growing body of knowledge.

2. MATERIALS AND METHODS

2.1 Sample Preparation

The pulp of fresh ripe samples of pawpaw (*Carica papaya L*), banana (*Musa paradisiaca*), apple (*Malus domestica*), orange (*Citrus sinensis*), guava (*Psidium guajava*), watermelon (*Citrus lanatus*), soursop (*Annona muricata*), bush mango (* Irvingia gabonensis*) and pineapple (*Ananus comosus*) were purchased at Rumuolumeni market in Port Harcourt, Rivers State, Nigeria. They were washed in distilled water and refrigerated for a day to prevent spoilage before extraction of juice for laboratory analysis. Banana, guava, bush mango, pineapple, soursop and pawpaw were blended in moulinex blender separately and the juice were sieved into different clean beakers while the apple, orange, and watermelon juices were extracted using juice extractor into a clean beaker before the analysis.

2.2 Proximate Composition

The ash, moisture, dry matter, crude protein and lipid composition of samples were determined using the standard methods [14].

2.3 Determination of Mineral Composition

Two grams of each sample of fruits were dried and ashed at 500°C for 1hr. The ash was dissolved in 10% 25ml HCl and made up to 100ml with deionized water in a standard flask. Ca, Mg, K, Zn, Fe, contents were determined according to [14] using Atomic Absorption Spectrophotometer (AAS) (Perkin-Elmer Model 372).

3. RESULTS AND DISCUSSION

Table 1 shows the proximate composition of the fruits investigated, moisture content varied between 75.00±01.34% for *Citrus sinensis* to 89.60±3.52% for *Citrus lanatus*. The moisture contents for *M. paradisiaca* (79.58±2.10%), *C. lanatus* (89.60±3.52%) and *A. comosus* (85.07±2.50%) were lower than the reported value by [15] for *M. paradisiaca* (81.1%), *C. lanatus* (96.4%) and *A. comosus* (86.4%) respectively. Also higher moisture contents were reported for *A. comosus* (87.3%) and *C. sinensis* (90.3%) respectively [16]. The moisture content values for *C. papaya L.* (87.30±4.32%) and *P. guajava* (80.53±3.54%) in this work are comparable to the values reported by [17] for *C. papaya L.* (87.67%) and *P. guajava* (82.00%) respectively. All the fruits studied had high moisture content which is typical of
fresh fruits at maturity [18]. The high moisture content in fruits provides part of the medium for normal functioning of enzymes and general metabolic processes.

There is no significant difference between the ash content of *C. sinensis* (2.05±0.30%), *I. gabonensis* (2.50±0.34%) and *C. lanatus* (2.50±0.23%). The ash content value compared favourably with most fruits’ value [19] but lower than those reported by [20]. The percentage ash of the sample gave an idea about the inorganic content of the samples from where the mineral content could be obtained. Samples with high percentages of ash contents are expected to have high concentrations of various mineral elements, which are expected to speed up metabolic processes and improve growth and development [1].

The observed wide range in moisture and dry matter in the fruits are similar to those reported by Kohler and Bickoff [21] and this accounts for rapid deterioration of fruits if left unprocessed for long time after harvesting. The carbohydrate content of these fruits ranged from 7.50±0.64% to 18.46±2.80%. Samples with low carbohydrate content might be ideal for diabetic and hypertensive patients requiring low sugar diets. The crude protein content showed generally low values. The protein concentration ranged from 0.29±0.01% to 1.28±0.10% for *M. domestica* and *P. guajava*. Proteins are essential component of diet needed for survival of animals and human beings whose basic function is to supply adequate amounts of required amino acids for nutrition [22]. Protein deficiency causes growth retardation, muscle wasting, edema, abnormal swelling of the belly and collection of fluids in the body [23].

The mineral compositions of the fruits’ samples were reported in Table 2. Potassium is the most abundant mineral found in the fruits followed by Mg > Ca > Fe > Zn respectively. The levels of potassium ranges from 26.15±4.21 mg/g for *A. muricata* to 380.05±6.85 mg/g in *M. paradisiaca*. A similar value for *M. paradisiaca* is reported by [7] and [24] as (398.56 mg/g) and (400 mg/g) respectively. It is different for *P. guajava* (86.66 mg/g), *C. papaya* L. (27.12 mg/g) *M. domestica* (86.66 mg/g) and *C. sinensis* (27.12 mg/g). The least calcium level was in *C. lanatus* (7.00±0.04 mg/g), and highest in *C. papaya* L. (84.90±3.57 mg/g).

The values obtained for *A. comosus* (16.45±1.50 mg/g), *C. lanatus* (7.00±0.04 mg/g), *M. paradisiaca* (7.24±0.05 mg/g) were similar to that of Ihekoronye and Ngoddy [25], (16.00, 7.00, 7.24 mg/g), but different for *C. papaya* L. (15.80 mg/g). Also the calcium content is similar to the work of Onibon et al., [7] for *P. guajava* (14.56 mg/g) but lower for *M. paradisiaca* (0.016 mg/g), *M. domestica* (0.88 mg/g), *C. sinensis* (0.93 mg/g) and *C. papaya* L. (29.64 mg/g) respectively.
Table 1. Proximate composition of some fruits samples (%)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Moisture (%)</th>
<th>Ash (%)</th>
<th>Dry matter (%)</th>
<th>Carbohydrate (%)</th>
<th>Protein (%)</th>
<th>Lipid (%)</th>
<th>Crude fibre (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>79.58±2.10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.30±0.01&lt;sup&gt;c&lt;/sup&gt;</td>
<td>20.42±1.50&lt;sup&gt;abc&lt;/sup&gt;</td>
<td>15.95±1.72&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.25±0.21&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.99±0.05&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.75±0.03&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>B</td>
<td>80.53±3.54&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.53±0.41&lt;sup&gt;b&lt;/sup&gt;</td>
<td>19.47±2.14&lt;sup&gt;abc&lt;/sup&gt;</td>
<td>15.43±1.26&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.28±0.10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.53±0.02&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.21±0.01&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>C</td>
<td>87.30±4.32&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.27±0.01&lt;sup&gt;c&lt;/sup&gt;</td>
<td>12.70±1.32&lt;sup&gt;c&lt;/sup&gt;</td>
<td>18.26±2.51&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.82±0.02&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.65±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.23±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>D</td>
<td>75.00±1.34&lt;sup&gt;abc&lt;/sup&gt;</td>
<td>2.05±0.30&lt;sup&gt;a&lt;/sup&gt;</td>
<td>25.00±3.13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>18.46±2.80&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.87±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.11±0.00&lt;sup&gt;d&lt;/sup&gt;</td>
<td>3.55±0.02&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>E</td>
<td>85.05±4.10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.50±0.01&lt;sup&gt;c&lt;/sup&gt;</td>
<td>14.95±4.21&lt;sup&gt;c&lt;/sup&gt;</td>
<td>13.55±0.94&lt;sup&gt;abc&lt;/sup&gt;</td>
<td>0.29±0.01&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.40±0.01&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.00</td>
</tr>
<tr>
<td>F</td>
<td>89.60±3.52&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.50±0.23&lt;sup&gt;a&lt;/sup&gt;</td>
<td>10.40±0.63&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7.50±0.64&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.05±0.01&lt;sup&gt;abc&lt;/sup&gt;</td>
<td>0.55±0.02&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>1.50±0.30&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>G</td>
<td>80.25±1.25&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.03±0.11&lt;sup&gt;b&lt;/sup&gt;</td>
<td>19.75±0.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>16.05±1.32&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.51±0.05&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.69±0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.77±0.02&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>H</td>
<td>77.30±1.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.50±0.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>22.70±1.2&lt;sup&gt;abc&lt;/sup&gt;</td>
<td>15.97±1.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.61±0.03&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.21±0.01&lt;sup&gt;d&lt;/sup&gt;</td>
<td>3.50±0.05&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>I</td>
<td>85.07±2.50&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.23±0.15&lt;sup&gt;b&lt;/sup&gt;</td>
<td>14.93±2.54&lt;sup&gt;c&lt;/sup&gt;</td>
<td>12.06±1.62&lt;sup&gt;abc&lt;/sup&gt;</td>
<td>0.39±0.02&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.10±0.00&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.61±0.01&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Mean ± standard deviation of triplicate determinations.
Mean with the same superscripts in the same column are not significantly different (P ≥ 0.05).
Table 2. The result of the mineral composition of the fruits analysed (mg/g)

<table>
<thead>
<tr>
<th>Samples of fruits</th>
<th>K</th>
<th>Fe</th>
<th>Ca</th>
<th>Mg</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>380.05±6.85</td>
<td>0.86±0.01</td>
<td>7.24±0.05</td>
<td>45.71±4.55</td>
<td>0.45±0.01</td>
</tr>
<tr>
<td>B</td>
<td>166.18±2.58</td>
<td>2.40±0.01</td>
<td>16.46±1.02</td>
<td>15.67±1.13</td>
<td>0.06±0.01</td>
</tr>
<tr>
<td>C</td>
<td>358.37±4.67</td>
<td>0.46±0.02</td>
<td>84.90±3.57</td>
<td>44.04±2.10</td>
<td>0.24±0.00</td>
</tr>
<tr>
<td>D</td>
<td>125.00±5.90</td>
<td>0.40±0.02</td>
<td>7.00±0.04</td>
<td>30.21±1.40</td>
<td>0.75±0.02</td>
</tr>
<tr>
<td>E</td>
<td>26.15±4.21</td>
<td>1.40±0.03</td>
<td>17.43±2.10</td>
<td>32.50±1.23</td>
<td>0.57±0.01</td>
</tr>
<tr>
<td>F</td>
<td>77.95±5.34</td>
<td>3.21±0.56</td>
<td>14.35±1.50</td>
<td>14.67±2.49</td>
<td>1.26±0.30</td>
</tr>
<tr>
<td>G</td>
<td>126.36±4.27</td>
<td>1.19±0.30</td>
<td>33.35±4.26</td>
<td>20.10±1.68</td>
<td>0.35±0.01</td>
</tr>
<tr>
<td>H</td>
<td>280.10±8.58</td>
<td>0.43±0.01</td>
<td>18.65±1.20</td>
<td>27.12±3.48</td>
<td>0.51±0.02</td>
</tr>
<tr>
<td>I</td>
<td>261.03±7.77</td>
<td>3.28±0.20</td>
<td>16.45±1.50</td>
<td>25.20±1.30</td>
<td>0.15±0.01</td>
</tr>
</tbody>
</table>

Mean ± standard deviation of triplicate determinations.

Mean with the same superscripts in the same column are not significantly different (P ≥ 0.05) A= Musa paradisiaca, B= Psidium guajava, C= Carica papaya, L= Citrus lanatus, E= Annona muricata, F= Irvingia gabonensis, G= Citrus sinensis, H= Malus domestica, I= Ananus comosus.

The iron content of I. gabonensis is similar to that of A. comosus and P. guajava but significantly different from M. paradisiaca, C. papaya L., C. lanatus, and M. domestica respectively. A lower iron content was reported [25] for C. Papaya L. (0.40 mg/g), C. lanatus (0.20 mg/g), A. comosus (0.30 mg/g) and C. sinensis (0.40 mg/g) and higher for M. paradisiaca (0.93 mg/g) compared to this work. Higher concentrations of iron was obtained in this study compared to the values obtained by [7] for M. paradisiaca (0.28 mg/g), M. domestica (0.28 mg/g), P. guajava (0.28 mg/g), C. papaya L., C. sinensis (0.19 mg/g). The value of 3.21 mg/g for I. gabonensis in this work is small compared to 64.58 mg/g [26].

The magnesium content for M. paradisiaca is similar to that of C. papaya L and significantly different from I. gabonensis, C. sinensis and P. guajava respectively. Higher magnesium concentrations are reported in this work compared to the work of Onibon et al. (2007) for M. paradisiaca (0.05 mg/g), M. domestica (13.29 mg/g), P. guajava (13.29 mg/g) C. sinensis (0.85 mg/g) and C. papaya L. (28.24 mg/g). Also the values for C. sinensis (26 mg/kg) and A. comosus (36 mg/kg) are lower as reported in Falade et al., 2003 [16]. Magnesium is required for our body’s muscular contraction.

The zinc concentration for I. gabonensis is significantly different from the other fruits studied. The reported values of 0.48 mg/g, 22.9 mg/g, 22.9 mg/g, 0.1 mg/g, 0.10 mg/g for M. paradisiaca, M. domestica, P. guajava, C. sinensis, and C. papaya L., reported in Onibon et al., 2007 [7] were lower for M. paradisiaca, 0.45 mg/g, M. domestica, 0.51 mg/g, P. guajava 0.06 mg/g but higher for C. sinensis 0.35 mg/g, and C. papaya L., 0.24 mg/g in this present work. Ayivor et al., 2011 [26] reported zinc content of (6.72 mg/g) for I. gabonensis which is higher than (1.26 mg/g) reported in this work. The differences in result could be due to environmental and method of analysis.

4. CONCLUSION

C. lanatus had the highest composition of moisture and ash, C. sinensis for crude fibre and carbohydrates, lipid was M. paradisiaca, while protein was P. guajava respectively. It can be concluded that the edible parts of the fruits studied are rich in nutrients. This work indicates
that the best sources of potassium, magnesium and calcium are banana and pawpaw while pineapple and bush mango are rich in iron and zinc respectively.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES


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